The Bloch Simulator: Interactive MR physics directly in a browser

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Presentation Abstract

Presentation: **The Bloch Simulator: Interactive MR physics directly in a browser**

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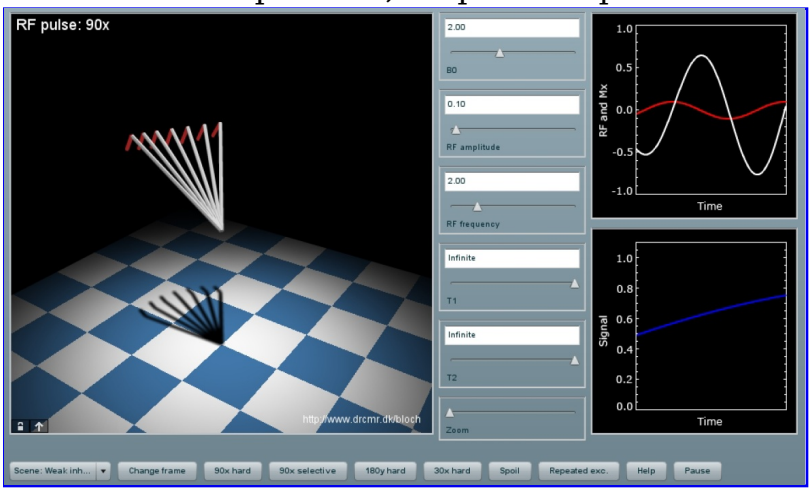
Abstract: **Purpose of the software:** The Bloch Simulator is award-winning software [1] made for teaching basic and advanced MR techniques. With the aid of 3D graphics, a wide range of MR phenomena can be explored interactively.
The software is aimed at lecturers and students alike. Lecturers may use it in classroom demonstrations, for example, while students may solve given exercises, or simply explore spin dynamics on their own.
The software is freely available [2] and executes on basically any computer, directly off the internet with no need for installation of software. Examples of it's use is given at Youtube and at the exhibit.
Implementation: The Bloch Simulator solves the Bloch equations [3] numerically for fields and conditions that are changed interactively by the user, e.g. to reflect the events during a particular MR sequence.
The original implementation is described in [4]. The

software was recently rewritten to run directly in a browser, which improves accessibility much. The current implementation is based on Flash/ActionScript which is used on countless web pages and is supported by most browsers. Download for offline use is still an option.

Features illustrated at the exhibit: Users of the software can experiment with sample magnetizations, fields and sequence elements interactively. Typically a demonstration of a sequence starts with the magnetization of one or more isochromats in thermal equilibrium. The user may now adjust the B0 or B1 fields to explore excitation, or may experiment with the effects of one or more RF pulses and subsequent relaxation, e.g. to find out how a particular weighting can be obtained in a sequence involving repeated excitation. Also 1D k-space imaging can be explored.

For the exhibit, users are encouraged to bring their own laptops, get a copy of the software, and experiment themselves. Inspiration, help and explanations is provided.



The white bars illustrate the magnetization of isocromates while red bars indicate the push on these by radio waves (the torques). The screen shot is taken during excitation in presence of a field gradient.

References:

[1] The Bloch Simulator won the ESMRMB Info-RESO award 2009.

[2] http://www.drcmr.dk/bloch, Tutorials, videos, downloads and more.

[3] Bloch F, Nuclear induction, Phys Rev 70:460-73, 1946.

[4] Hanson LG, A Graphical Simulator for Teaching Basic and Advanced MR Imaging Techniques, RadioGraphics 27,

http://radiographics.rsna.com/content/27/6/e27, 2007.